

# Hemorrhage After Pancreatoduodenectomy

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## Objective

The authors reviewed the hemorrhagic complications of patients who underwent pancreatoduodenectomies between 1972 and 1996.

## Summary Background Data

Although recent studies have demonstrated a reduction in the mortality of pancreatic resection, morbidity is still high. Bleeding is a close second to anastomotic dehiscence in the list of dangerous postoperative complications.

## Methods

The medical records from a prospective data bank of 559 patients who underwent pancreatic resection at the Surgical Clinic of Mannheim (Heidelberg University) were analyzed in regard to postoperative hemorrhagic complications. Differences were evaluated with the Fisher exact test.

## Results

The overall mortality rate was 2.7%. Postoperative bleeding occurred in 42 patients (7.5%), with 6 episodes ending fatally (14.3%). Erosive bleeding after pancreatic leak was noted in 11 patients (26.2%), 4 of whom died. Gastrointestinal hemorrhage occurred in 22 patients, and operative field hemorrhage was present in 20 cases. Relaparotomy was necessary in 29 patients. An angiography with interventional embolization for recurrent bleeding was performed in three patients. Seven hemorrhages (4.6%) occurred after pancreatectomy for chronic pancreatitis and 35 episodes of bleeding (8.6%) were encountered after pancreatectomy for malignant disease. Obstructive jaundice was present in 359 patients (63.9%). In this group of patients, 32 (8.9%) postoperative hemorrhages occurred. Preoperative biliary drainage did not influence the type and mortality rate of postoperative hemorrhage in jaundiced patients.

## Conclusion

The prevention of these bleeding complications depends in the first place on meticulous hemostatic technique. Preoperative biliary drainage does not lower postoperative bleeding complications in jaundiced patients. Continuous, close observation of the patient in the postoperative period, so as to detect complications in time, and expeditious hemostasis are paramount.

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**Table 1. EARLY RESULTS OF DUODENOPANCREATECTOMY IN 559 PATIENTS: SURGICAL UNIVERSITY CLINIC MANNHEIM, JANUARY 10, 1972 TO JANUARY 1, 1996**

Procedure	Number of Patients	Diagnosis		Operation + Hospital Mortality
		Neoplasm	Pancreatitis	
Whipple operation	499	365 (10)	134 (1)	11
Total	60	43 (3)	17 (1)	4
pancreatectomy				
Total	559	408 (13)	151 (2)	15 (2.7%)

Although the operative mortality of pancreatoduodenectomy has recently fallen to acceptable levels,<sup>1,2</sup> morbidity remains high.<sup>3,4</sup> This paper analyses the early postoperative hemorrhagic complications after 559 pancreatoduodenectomies performed during the past 24 years in the Surgical University Clinic Mannheim.

## PATIENTS AND METHODS

The clinical, operative, and pathologic data of 559 consecutive patients who underwent duodenopancreatectomy at the Surgical Clinic of Mannheim (Heidelberg University) between October 1972 and January 1996 were cumulated into a prospective database. The study included 374 men and 185 women ranging in age from 19 to 82 years (median 63 years). The indications for pancreatectomy were adenocarcinoma of the pancreas or periampullary malignancy (408 patients) and complicated chronic pancreatitis (151 patients). The preferred procedure was the Whipple operation. The overall mortality rate was 2.7% (Table 1). Operative mortality was defined as death occurring during the hospital stay or as a consequence of a postoperative complication.

Statistical analysis was performed using the Fisher exact test. A *p* value of 0.05 or less was considered significant.

## RESULTS

Postoperative bleeding occurred in 42 patients (7.5%), with 6 episodes ending fatally (14.3%). Erosive bleeding

after a pancreatic leak was noted in 11 patients (26.2%), 4 of whom died.

Gastrointestinal hemorrhage occurred in 22 patients, and operative field hemorrhage was present in 20 cases (including 11 erosive bleedings caused by breakdown of the pancreatojejunal anastomosis). In 13 patients with gastrointestinal (*i.e.*, intraluminal) hemorrhage, hemostasis was achieved by endoscopic measures; 9 of the gastrointestinal and all of the operative field bleedings required relaparotomy (Table 2).

Of the operative field hemorrhages, 6 (30%) were of surgical origin, 3 (15%) were diffuse, and 11 were erosive bleedings after pancreatic leaks. An angiography with interventional embolization of a false aneurysm for recurrent bleeding was performed successfully in three patients.

Thirty-eight hemorrhages (7.6%) occurred after Whipple resection and 4 (6.6%) after total pancreatectomy. Seven hemorrhages (4.6%) occurred after pancreatectomy for chronic pancreatitis and 35 (8.6%) after pancreatectomy for malignant disease. The location of the malignant tumor did not influence the hemorrhagic complication (Table 3).

Obstructive jaundice was present in 359 patients (63.9%). In this group of patients, 32 (8.9%) postoperative hemorrhages were noted. The occurrence of gastrointestinal bleeding differed significantly for jaundiced patients and patients without biliary obstruction (*p* < 0.05) (Table 4).

Two hundred eighteen jaundiced patients (60.7%) received a preoperative biliary drainage. In this group, postoperative hemorrhage occurred in 19 patients (8.7%). There was no difference between patients who received and those who did not receive a preoperative biliary stent (Table 5). Coagulation studies were within normal limits in all patients. Thus, preoperative biliary drainage did not influence the type and mortality rate of postoperative hemorrhage in jaundiced patients (Table 6).

**Table 2. HEMORRHAGIC COMPLICATIONS, RELAPAROTOMY, AND MORTALITY RATE OF 559 PANCREATECTOMIES: SURGICAL UNIVERSITY CLINIC MANNHEIM, JANUARY 10, 1972 TO JANUARY 1, 1996**

Site of Hemorrhage	Number	Relaparotomy	Mortality
Gastrointestinal	22	9	1
Operative field	20	20	5
(erosive bleeding)	(11)	(11)	(4)
Total	42	29	6

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**Table 3. TUMOR LOCALIZATION, HEMORRHAGIC COMPLICATIONS, AND MORTALITY RATE OF 559 PANCREATECTOMIES: SURGICAL UNIVERSITY CLINIC MANNHEIM, JANUARY 10, 1972 TO JANUARY 1, 1996**

Tumor Localization	Number of Patients	Hemorrhages [number (%)]	Mortality of Hemorrhage [number (%)]
Pancreas	243	22 (8.9)	3 (1.2)
Papilla	98	9 (9.2)	2 (2.0)
Periampullary	67	4 (6.0)	—
Chronic complicated pancreatitis	151	7 (4.6)	1 (0.7)
Total	559	42 (7.5)	6 (1.1)

## DISCUSSION

The frequency of hemorrhagic complications after pancreatoduodenectomy (2%–18%) has not changed over the last 20 years.<sup>5–14</sup> Where reported, the mortality rate for this complication ranges from 30% to 58%.<sup>15–22</sup>

In principal, one must differentiate between gastrointestinal (*i.e.*, intraluminal) bleeding and hemorrhage from the large raw surface of the retroperitoneal operative field. Both types of bleeding can occur in the early postoperative stage as well as later (up to 2 weeks after the operation).

### Early Postoperative Hemorrhage

Management of an early postoperative hemorrhage is generally simple and identical to the management of

**Table 5. JAUNDICE, PREOPERATIVE BILIARY DRAINAGE, AND HEMORRHAGIC COMPLICATIONS IN 359 PATIENTS: SURGICAL UNIVERSITY CLINIC MANNHEIM, JANUARY 10, 1972 TO JANUARY 1, 1996**

Treatment of Preoperative Jaundice	Number of Patients	Number (%) of Hemorrhages
With preoperative biliary drainage	218	19 (8.7)
Without preoperative biliary drainage	141	13 (9.2)
Total	359	32 (8.9)

bleeding complications after extensive abdominal surgery. If there is the slightest suspicion of gastrointestinal bleeding (*e.g.*, blood in the nasogastric tube, melena, or a drop in hemoglobin or blood pressure), gastroscopy must be carried out. The presence of a 24-hour endoscopy service (staffed by surgeons) is invaluable. In our series, the cause of all cases of real gastrointestinal bleeding was suture line oozing, never bleeding from a “stress ulcer.” If interventional endoscopy fails, relaparotomy is mandatory. Early relaparotomy with gastrotomy (above the gastrojejunal anastomosis) and an additional suture will usually stop the bleeding.

Simple postoperative hemorrhage from the operative field should be approached with a relaparotomy for easier management. The patient will benefit most from the relap-

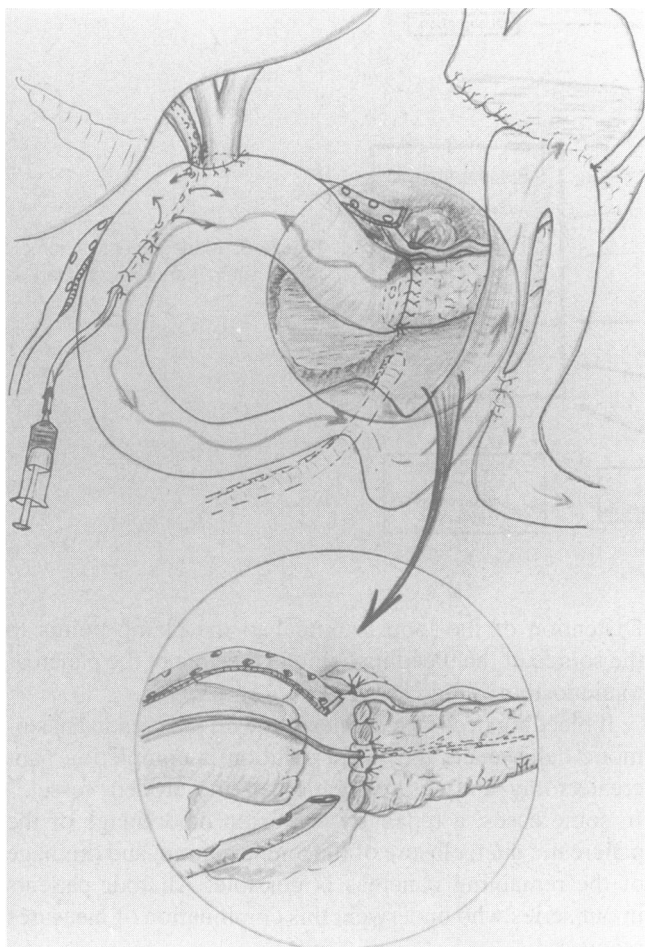
**Table 4. JAUNDICE AND HEMORRHAGE COMPLICATIONS IN 559 PATIENTS: SURGICAL UNIVERSITY CLINIC MANNHEIM, JANUARY 10, 1972 TO JANUARY 1, 1996**

Site of Hemorrhage	Jaundice [number (%)]	No Jaundice [number (%)]
Gastrointestinal (endoscopic treatment)	9 (69)	4 (31)
Gastrointestinal (operative treatment)	9	—
Operative field	4 (44)	5 (56)
Erosive bleeding	10 (91)	1 (9)
Total	32	10

**Table 6. TYPES OF HEMORRHAGE, RELATED TO PREOPERATIVE BILIARY DRAINAGE IN 359 JAUNDICED PATIENTS: SURGICAL UNIVERSITY CLINIC MANNHEIM, JANUARY 10, 1972 TO JANUARY 1, 1996**

Hemorrhage Site in Jaundiced Patients	PBD [number (%)]	No PBD [number (%)]
Gastrointestinal (endoscopic treatment)	4 (44)	5 (56)
Gastrointestinal (surgical treatment)	6 (66)	3 (34)
Operative field	4	—
Erosive bleeding	5 (50)	5 (50)
Total number (%) of patients	19 (8.7)	13 (9.2)

PBD = preoperative biliary drainage.

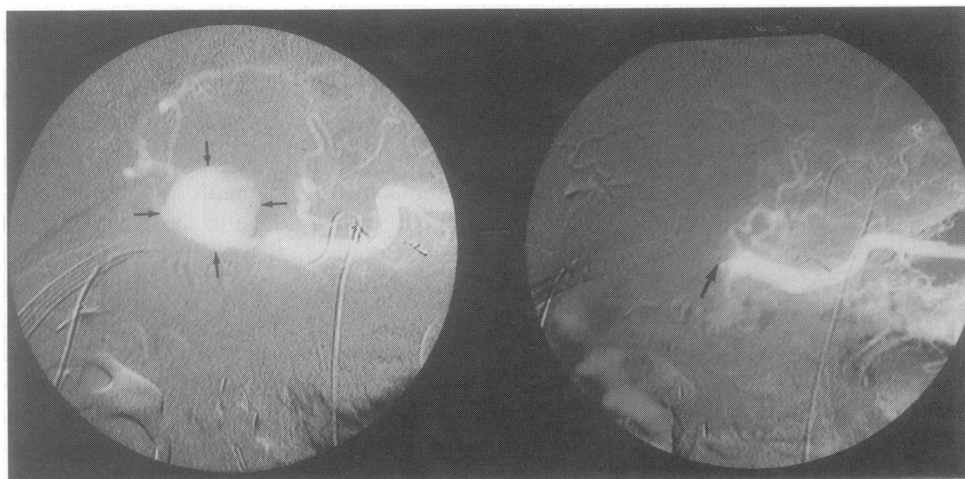


**Figure 1.** (Top) Erosive bleeding after the Whipple procedure. Injection of milk through the Völker drainage tube during endoscopy or an intraoperative clamping procedure can be helpful in localizing the source of bleeding. (Bottom) Repair by suture of this vessel, closure of the jejunal stump, oversewing and drainage of the pancreatic duct, and irrigation-suction drain.

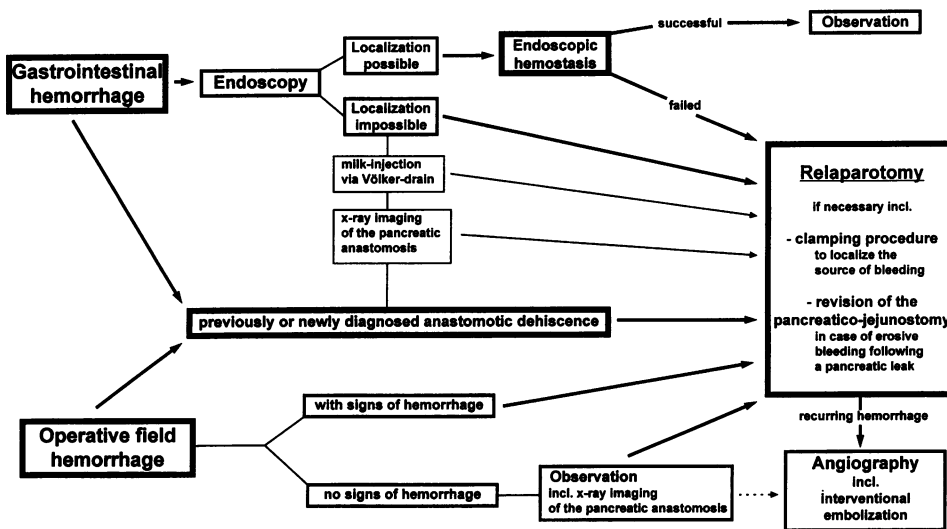
arotomy if a careful anesthesiologist can avoid aspiration during induction of anesthesia, which is all too often followed by prolonged mechanical ventilation.

Some intraoperative technical mishap is generally considered the prime cause of early postoperative bleeding, notably a suture line that is not really hemostatic or a slipped ligature. However, the analysis of operative field hemorrhage requiring relaparotomy indicates that only 30% were due to surgical errors. The other cases were diffuse in nature or occurred as a consequence of a pancreatic leak. Because true operative field bleeding occurred in jaundiced patients and nonjaundiced patients alike, coagulation defects cannot be blamed. It is likely that the relatively large raw surface of the operative field after extensive lymphadenectomy is conducive to the occurrence of diffuse bleeding.

Unlike operative field bleeding, gastrointestinal bleeding occurred more often in jaundiced patients. However, coagulation analysis at the time of surgery was normal for all patients. True coagulation defects are rarely identifiable by routine laboratory analysis, although it seems that patients who present with obstructive jaundice are at greater risk from this complication, even after vitamin K substitution.<sup>23,24</sup> In practice, these patients are particularly prone to complications involving hemorrhage, infection, and anastomotic dehiscence, possibly resulting from endotoxemia.<sup>5,25-27</sup> This was confirmed in our series, where >90% of cases of erosive bleeding occurred in jaundiced patients as a consequence of a pancreatic leak. Preoperative biliary drainage, however, did not influence the rate of complications, an observation that coincides with the observations made by other authors.<sup>12,28-30</sup> The average time between insertion of the drainage and surgery was 13 days. There can be no illusion about recovery of all the mitochondrial functions of hepatocytes within the time available.<sup>31</sup> According to Koyama et al.,<sup>32</sup> it takes up to



**Figure 2.** Patient WB, a 67-year-old man. Angiography for recurrent hemorrhage 16 days after Whipple pancreatoduodenectomy for papillary carcinoma. (A) (left side) A. hep. sin. aneurysm. (B) (right side) Angiography after interventional embolization.



**Figure 3.** Management of hemorrhage after pancreatoduodenectomy.

6 weeks of decompression before hepatic mitochondrial functions return to normal, far longer than is practicable in most patients (particularly those with pancreatic cancer).

### Late Postoperative Hemorrhage

More difficult is the diagnosis of, or the decision to intervene in, bleeding after the first week. Of course, some cases of gastrointestinal or operative field bleeding that occur during that time can be easily and safely handled with endoscopy or surgery. However, these hemorrhages often result from erosion of a ligated artery after a pancreatic leak. They may also present as hematemesis or melena (*i.e.*, as an "intraluminal" bleed). In our series, four patients had a "sentinel bleed,"<sup>33</sup> mimicking a gastrointestinal bleed, advertising erosive bleeding after a pancreatic leak.

In all cases of bleeding in the late postoperative stage, breakdown of the pancreatojejunal anastomosis must be excluded as a possible cause of the bleeding. Therefore, clinical signs, elicited by close observation of the patient, are often of more value than modern laboratory or imaging procedures.

A complication at the pancreatojejunal anastomosis should always be considered if gastroscopy does not localize a clear source of bleeding within the stomach or the gastrojejunal anastomosis. The injection of milk through the Völker drainage tube placed in the afferent jejunal loop with the gastroscope in place can provide a clue. If white milk emerges from the afferent loop, it is unlikely that the bleeding stems from the pancreatojejunal anastomosis. If it is impossible to pinpoint the cause of the bleeding endoscopically, a relaparotomy is imperative. Clamping of the afferent jejunal loop at the beginning of the procedure can be of help in localizing the bleeding.

Distention of the loop proximal to the clamp points to the source of the bleeding being in the area of the pancreatojejunal anastomosis (Fig. 1).

If bleeding occurs in connection with pancreatic anastomotic dehiscence, the safest solution is completion pancreatectomy and suture ligation of the eroded vessel.<sup>34</sup> In some cases, a repair by occlusion or drainage of the pancreatic duct, closure of the jejunal stump, and drainage of the remaining pancreas is possible. All four patients in our series who underwent this combination of measures recovered.

If a pancreatic leak has already been diagnosed but conservatively treated due to apparently insignificant clinical symptoms, the occurrence of "sentinel bleeding" should be taken very seriously and should lead to immediate relaparotomy with revision of the pancreatojejunal anastomosis.

In some cases of operative field bleeding, the performance of an angiography with the possibility of interventional embolization can be beneficial. Occasionally, superselective embolization may be effective (Fig. 2). This intervention should also be considered in the case of recurrent bleeding, especially if it was impossible to localize the source of the bleeding during the first revision.

Figure 3 gives guidelines for the management of hemorrhagic complications after pancreatoduodenectomy. Due to the complexity of this algorithm, it can give only a rough idea of the possible diagnostic and therapeutic modalities. It can be applied only in conjunction with a diligent analysis of the presented symptoms.

Finally, there are three rules that can minimize the occurrence of bleeding complications and optimize the management of bleeding once it has occurred: 1) optimal preoperative preparation of the patient, including neutralization of the deleterious effects of obstructive jaundice

as much as possible; 2) meticulous attention to detail during the operation; and 3) continuous, close observation of the patient in the postoperative period so as to detect complications in time.

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